Search of Room Temperature Ferromagnetic Semiconductors in doped In2O3

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One of the major technical barriers to realize the practical implementation of spin-controlled semiconductor devices is the development of spin injection contact materials that will effectively inject spin polarized electrons into semiconductors. One approach is the development of room temperature, soft ferromagnetic semiconductors. Based on Intematix proprietary combinatorial technology, the materials systems with high solubility of magnetic dopants in the host lattice were identified. Especially transition metal doped In2O3, well-known wide bandgap semiconductor, was found to have impurity-free, room temperature ferromagnetism with high solubility of dopants. In contrast to many previously reported diluted ferromagnetic semiconductors, the thermodynamic solubility of magnetic Fe ions in the host lattice exceeds 20 percents. Extensive structural, magnetic and transport studies were carried out to rule out possible contributions from magnetic impurities. With many emerging new diluted magnetic semiconductor materials troubled by magnetic impurities, the impurity-free magnetism in doped In2O3 raises a significant possibility of spin polarization in this wide bandgap semiconductor. The high solubility limit of magnetic ions in this system is very attractive for material growth and device application. It is paramount to supplement the discovery of new magnetic semiconductor materials with careful material characterization before one can realize a thin film device to confirm its spin injection efficiency, thus paving the way for a wide range of practical device applications. The central part of magnetic characterization will be XMCD experiments. The valence state of magnetic elements can provide vital information about its magnetic state and its correlation to co-dopants.

This talk will also include a brief intro and chronology of spin injection schemes and diluted magnetic semiconductors.